Decision Rationale

Total Maximum Daily Load of
Fecal Coliform for Holmans Creek

I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those water bodies identified as impaired by the state where technology-based and other controls did not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a margin of safety, that may be discharged to a water quality-limited water body.

This document will set forth the Environmental Protection Agency's (EPA) rationale for establishing the TMDL of Fecal Coliform for Holmans Creek. EPA's rationale is based on the determination that the TMDL meets the following eight regulatory conditions pursuant to 40 CFR §130.

1) The TMDL is designed to implement applicable water quality standards.
2) The TMDL includes a total allowable load as well as individual waste load allocations and load allocations.
3) The TMDL considers the impacts of background pollutant contributions.
4) The TMDL considers critical environmental conditions.
5) The TMDL considers seasonal environmental variations.
6) The TMDL includes a margin of safety.
7) The TMDL has been subject to public participation.
8) There is reasonable assurance that the TMDL can be met.

II. Background

The 12,000 acre Holmans Creek watershed is located in Shenandoah and Rockingham Counties. The TMDL addresses the full 11 mile stream segment, from its headwaters to the its confluence with the North Fork of the Shenandoah River. Improved pasture and forest are the major land uses in the watershed and make up roughly 72% of the 12,000 acre watershed.

In response to Section 303(d) of the Clean Water Act CWA, the Virginia Department of Environmental Quality (VADEQ) listed 15.78 miles of Holmans Creek as being impaired by elevated levels of fecal coliform on Virginia's 1998, Section 303(d) list. Holmans Creek was listed for violations of Virginia's fecal coliform bacteria water quality standard (WQS) and general (benthic) water quality

standard. Fecal Coliform is a bacterium which can be found within the intestinal tract of all warm blooded animals. Therefore, fecal coliform can be found in the fecal wastes of all warm blooded animals. Fecal coliform in itself is not a pathogenic organism. However, fecal coliform indicates the presence of fecal wastes and the potential for the existence of other pathogenic bacteria. The higher concentrations of fecal coliform indicate the elevated likelihood of increased pathogenic organisms.

EPA has been encouraging the states to use e-coli and enterococci as the indicator species instead of fecal coliform. A better correlation has been drawn between the concentrations of e-coli (and enterococci) and the incidence of gastrointestinal illness. The Commonwealth is pursuing to change the standard from fecal coliform to e-coli.

Virginia designates all of its waters for primary contact, therefore, all waters must meet the current fecal coliform standard for primary contact. Virginia's standard is to apply to all streams designated as primary contact for all flows. Through the development of this and other similar TMDLs, it was discovered that natural conditions alone (wildlife contributions to the streams) could cause violations of the standard during low flows. Thus, many of Virginia's TMDLs have called for some reduction in the amount of wildlife contributions to the stream. EPA believes that a significant reduction in wildlife is not practical and will not be necessary due to the implementation plan discussed below.

A phased implementation plan will be developed for all streams in which the TMDL calls for reductions in wildlife. The first phase of the implementation will reduce all sources of fecal coliform to the stream other than wildlife. In Phase 2, which can occur concurrently to Phase 1, the Commonwealth will consider addressing its standards to accommodate this natural loading condition. During Phase 2, the Commonwealth has indicated that it will evaluate the following items in relation to the standard. 1) The possibility of placing a minimum flow requirement upon the bacteriological standard. As a result, the standard may not apply to flows below the minimum (possibly 7Q10). This application of the standard is applied in many States. 2) The Commonwealth may develop a Use Attainability Analysis (UAA) for streams with wildlife reductions which are not used for frequent bathing. Depending upon the result of the UAA, it is possible that these streams could be designated primary contact infrequent bathing. 3) The Commonwealth will also investigate incorporating a natural background condition for the bacteriological indicator.

After the completion of Phase 1 of the implementation plan, the Commonwealth will monitor the stream to determine if the wildlife reductions are actually necessary, as the violation rate associated with the wildlife loading may be smaller than the percent error of the model. In Phase 3, the Commonwealth will investigate the sampling data to determine if further load reductions are needed in order for these waters to attain standards. If the load reductions and/or the new application of standards allow the stream to attain standards, then no additional work is warranted. However, if standards are still not being attained after the implementation of Phases 1 and 2, further work and reductions will be warranted.

Holmans Creek identified as watershed VAV-B45R, was given a high priority for TMDL development. Section 303(d) of the CWA and its implementing regulations require a TMDL to be developed for those waterbodies identified as impaired by the state where technology-based and other controls do not provide for the attainment of WQS. The TMDL submitted by Virginia is designed to determine the acceptable load of fecal coliform which can be delivered to Holmans Creek, as demonstrated by the Hydrologic Simulation Program Fortran (HSPF)[1], in order to ensure that the water quality standard is attained and maintained. HSPF is considered an appropriate model to analyze this watershed because of its dynamic ability to simulate both watershed loading and receiving water quality over a wide range of conditions.

The TMDL analysis allocates the application/deposition of fecal coliform to land based and instream sources. For land based sources, the HSPF model accounts for the buildup and washoff of pollutants from these areas. Buildup (accumulation) refers to all of the complex spectrum of dry-weather processes that deposit or remove (die-off) pollutants between storms.[2] Washoff is the removal of fecal coliform which occurs as a result of runoff associated with storm events. These two processes allow the HSPF model to determine the amount of fecal coliform from land based sources which is reaching the stream. Point sources and wastes deposited directly to the stream were treated as direct deposits. These wastes do not need a transport mechanism to allow them to reach the stream. The allocation plan calls for the reduction in fecal coliform wastes delivered by cattle in-stream, wildlife in-stream, and straight pipes.

Table 1 summarizes the specific elements of the TMDL.

Segment	Parameter	TMDL	WLA (cfu/yr)	LA (cfu/yr)	MOS (cfu/yr) [1]
Total	Fecal Coliform	1,421E+12	0.021E+12	1,353E+12	68E+12

1 Virginia includes an explicit MOS by identifying the TMDL target as achieving the total fecal coliform water quality concentration of 190 cfu/100ml as opposed to the WQS of 200 cfu/ml. This can be viewed explicitly as a 5% MOS.

EPA believes it is important to recognize the conceptual difference between the waste load allocation (WLA) values, load allocation (LA) values for sources modeled as direct deposition to stream segments, and LA values for flux sources of fecal coliform to land use categories. The WLA values and LA values for direct sources represent amounts of fecal coliform which are actually deposited into the stream segments. However, LA values for flux sources represent amounts of fecal

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[1]Bicknell, B.R., J.C. Imhoff, J.L. Little, and R.C. Johanson. 1993. Hydrologic Simulation Program-FORTRAN (HSPF): User's Manual for release 10.0. EPA 600/3-84-066. U.S. Environmental Protection Agency, Environmental Research Laboratory, Athens, GA.

[2]CH2MHILL, 2000. Fecal Coliform TMDL Development for Cedar, Hall, Byers, and Hutton Creeks Virginia,

coliform deposited to land. The actual amount of fecal coliform which reaches the stream segments will be significantly less than the amount of fecal coliform deposited to the land. The HSPF model, which considers landscape processes which affect fecal coliform runoff from land uses, determines the amount of fecal coliform which reaches the stream segments. The LA in Table 1 is the amount of cfu reaching the stream from nonpoint sources annually.

The United States Fish and Wildlife Service has been provided with copy of this TMDL.

III. Discussion of Regulatory Conditions

EPA finds that Virginia has provided sufficient information to meet all of the eight basic requirements for establishing a fecal coliform TMDL for Holmans Creek. EPA is therefore approving this TMDL. Our approval is outlined according to the regulatory requirements listed below.

1) The TMDL is designed to meet the applicable water quality standards.

Virginia has indicated that excessive levels of fecal coliform due to nonpoint sources (directly deposited into the River) have caused violations of the water quality standards and designated uses on Holmans Creek. The water quality criterion for fecal coliform is a geometric mean 200 cfu (colony forming units)/100ml or an instantaneous standard of no more than 1,000 cfu/100ml. Two or more samples over a 30 day period are required for the geometric mean standard. Therefore, most violations of the state's water quality standard are due to violations of the instantaneous standard.

The HSPF model is being used to determine the fecal coliform deposition rates to the land as well as loadings to the stream from point and other direct deposit sources necessary to support the fecal coliform water quality criterion and primary contact use. The following discussion is intended to describe how controls on the loading of fecal coliform to Holmans Creek will ensure that the criterion is attained.

The TMDL modelers determine the fecal coliform production rates within the watershed. Information is attained from a wide array of sources on the farm practices in the area (land application rates of manure), the amount and concentration of farm animals, point sources in the watershed, animal access to the stream, wildlife in the watershed, wildlife fecal production rates, land uses, weather, stream geometry, etc. This information was put into the model. The model then combines all the data to determine the hydrology and water quality of the stream.

A "paired watershed" approach was used in the hydrology calibration for Holmans Creek. A "paired watershed" approach was used because there was insufficient hydrology data on Holmans Creek. In a "paired watershed" approach, the modelers model the hydrology of a stream with a long term hydrologic record that would have a response similar to the watershed being studied (Holmans Creek).

Linville Creek, which is approximately 10 miles from Holmans Creek was the "paired watershed". The calibrated and validated Linville Creek hydrology model was adjusted to account for Holmans Creek's smaller watershed area and larger forested land use. USGS Station Number 01632082 is located on Linville Creek in Broadway, Virginia. The modelers had weather and stream flow data on Linville Creek from 1985. The calibration was run using the data from January 01, 1990 to December 31, 1995, this five-year period had both wet and dry weather conditions. The model simulated the observed conditions quite well.

A validation run was conducted to see how well the model simulated observed data over a different time period from Linville Creek. This was conducted to insure that the model could simulate different conditions in the Creek. The validation used data from January of 1996 through September of 1999. The simulated data from the validation compared favorably to the observed conditions as well.

Input variables were changed on the hydrology model prior transferring it to Holmans Creek. A three month hydrologic study was conducted on Holmans Creek from December of 1999 through March of 2000. The data obtained in this study was to develop input parameters for the Creek. The transferred model was run for the period of 1997 to 2000, it was calibrated to the 2000 observed data on the Creek as well.

EPA believes that using HSPF to model and allocate fecal coliform will ensure that the designated uses and water quality standards will be attained and maintained for Holmans Creek.

2) The TMDL includes a total allowable load as well as individual waste load allocations and load allocations.

Total Allowable Loads

Virginia indicates that the total allowable loading of fecal coliform is the sum of the loads allocated to land based, precipitation driven nonpoint source areas (Forest, Cropland, Orchard, Pasture 1, Pasture 2, Urban, and Farmstead), directly deposited nonpoint sources of fecal coliform (cattle in-stream, wildlife in-stream, and septic direct (lateral flow)), and point sources. Activities such as the application of manure, fertilizer, and the direct deposition of wastes from grazing animals are considered fluxes to the land use categories. The actual value for the total fecal load can be found in Table 1 of this document. The total allowable load is calculated on an annual basis due to the nature of HSPF model.

Waste Load Allocations

Virginia has stated that there are five point sources discharging to Holmans Creek. The

permitted point sources are: four single family residential sewage treatment facilities and Bowman Agricultural Enterprises. The single family residential sewage treatment plants are covered by Virginia general permit VAG40. These facilities are allowed to discharge 1,000 gallons per day with a fecal coliform concentration of 200 colony forming units (cfu)/100 mL. Therefore, these facilities were given a waste load allocation of 2.76E+10. Bowman Agricultural Enterprises is not currently online and therefore is not discharging to the Creek. Its WLA was determined by multiplying its allowable concentration (200 cfu/100 mL) by its permitted flow of 0.0075 million gallons per day.

EPA regulations require that an approvable TMDL include individual WLAs for each point source. According to 40 CFR 122.44(d)(1)(vii)(B), "Effluent limits developed to protect a narrative water quality criterion, a numeric water quality criterion, or both, are consistent with assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA pursuant to 40 CFR 130.7." Furthermore, EPA has authority to object to the issuance of any National Pollutant Discharge Elimination System (NPDES) permit that is inconsistent with the WLAs established for that point source. The WLA in the initial TMDL represents the loading from all permitted point sources, a revised TMDL was submitted to EPA by the Commonwealth on December 05, 2001 and documents WLAs for each facility.

Table 2 - Waste Load Allocations for Holmans Creek

Facility	Permit Number	Existing Load	Allocated Load
Single Family Unit	VAG401541	2.76E+09	2.76E+09
Single Family Unit	VAG401958	2.76E+09	2.76E+09
Single Family Unit	VAG401349	2.76E+09	2.76E+09
Single Family Unit	VAG401809	2.76E+09	2.76E+09
Bowman Agricultural Enterprises	VA0088285	2.07E+10	2.07E+10
Total	N/A	3.17E+10	3.17E+10

Load Allocations

According to Federal regulations at 40 CFR 130.2(g), LAs are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading, wherever possible natural and nonpoint source loads should be distinguished.

In order to accurately simulate landscape processes and nonpoint source loadings, VADEQ used the HSPF model to represent Holmans Creek watershed. The HSPF model is a comprehensive modeling system for simulation of watershed hydrology, point and nonpoint loadings, and receiving water quality for conventional pollutants and toxicants[3]. More specifically HSPF uses precipitation data for continuous and storm event simulation to determine total fecal loading to Holmans Creek from forest, cropland, orchard, pasture 1, pasture 2, urban, and farmstead lands. The total land loading of fecal coliform is the result of the application of manure, direct deposition from cattle and wildlife (geese, deer, etc.) to the land, fecal coliform production from dogs, and best management practices which have already been implemented on several farms reduce the loading of fecal coliform and sediment to streams.

In addition, VADEQ recognizes the significant loading of fecal coliform from cattle in-stream, straight pipes, wildlife in-stream, and failed septic systems. These sources are not dependent on a transport mechanism to reach a surface waterbody and therefore can impact water quality during low and high flow events. Table 3 illustrates the LA for the land application of fecal coliform, the loading to each land use. The load that reaches the stream from each land use will be significantly smaller than the amount of fecal coliform deposited to the land, quantities listed in the table.

Table 3 - LA for the land application of fecal coliform

Source	Existing Load(cfu/yr)	Allocated Load(cfu/yr)	Percent Reduction
Forest	1.2E+12	1.2E+12	0%
Cropland	86.4E+12	86.4E+12	0%
Orchard	125.0E+12	125.0E+12	0%
Pasture 1	993.0E+12	993.0E+12	0%
Urban	1.3E+12	1.3E+12	0%
Farmstead	1.3+E12	1.3+E12	0%
Pasture 2	143.0E+12	143.0E+12	0%
Septic	44.1E+12	0.0	100%
Wildlife In-Stream	20.1E+12	2.0E+12	90%
Cattle In-Stream	16.7E+12	0.0	100%

3) The TMDL considers the impacts of background pollution.

[3] Supra, footnote 2.

A background concentration was set by determining the wildlife loading to each land segment.

4) The TMDL considers critical environmental conditions.

EPA regulations at 40 CFR 130.7 (c)(1) require TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of Holmans Creek is protected during times when it is most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards[4]. Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence but when modeled to insure that water quality standards will be met for the remainder of conditions. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable "worst-case" scenario condition. For example, stream analysis often uses a low-flow (7Q10) design condition because the ability of the waterbody to assimilate pollutants without exhibiting adverse impacts is at a minimum.

The sources of bacteria for these stream segments were a mixture of dry and wet weather driven sources. Therefore, the critical condition for Holmans Creek was represented as a typical hydrologic year. However, the most stringent reductions were needed to insure that water quality standards were met during extreme low flows. It should be noted that low flow events occurred more often then wet weather events and therefore it was essential that the standard be maintained during these periods.

5) The TMDLs consider seasonal environmental variations.

Seasonal variations involve changes in stream flow as a result of hydrologic and climatological patterns. In the continental United States, seasonally high flow normally occurs in early spring from snow melt and spring rain, while seasonally low flows typically occur during the warmer summer and early fall drought periods. Consistent with our discussion regarding critical conditions, the HSPF model and TMDL analysis will effectively consider seasonal environmental variations. The model also accounted for the seasonal variation in loading. Fecal coliform loads changed for many of the sources depending on the time of the year. For example, cattle spent more time in the stream in the summer and

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[4]EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

animals were confined for longer periods of time in the winter.

6) The TMDLs include a margin of safety.

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. Margins of safety may be implicit, built into the modeling process by using conservative modeling assumptions, or explicit, taken as a percentage of the WLA, LA, or TMDL.

Virginia includes an explicit margin of safety by establishing the TMDL target water quality concentration for fecal coliform at 190 cfu/ 100mL, which is more stringent than Virginia's water quality standard of 200 cfu/100 mL. This would be considered an explicit 5% margin of safety.

7) The TMDLs have been subject to public participation.

Three public meetings were held to discuss TMDL development on Holmans Creek. All of the public meetings were public noticed in the *Virginia Register* and opened to a thirty-day comment period. The first meeting was held on April 12, 2000 in Forestville, VA. Twenty-five people attended this initial meeting on the TMDL. Around twenty people attended the second meeting which was held in New Market on July 27, 2000. The second public meeting focused on the TMDL's source assessment input data. The third and final public meeting was held on July 31, 2001 in New Market Town Hall. The meeting was attended by twenty-one people. The final public meeting focused on the draft TMDL.

8) There is a reasonable assurance that the TMDL can be met.

EPA requires that there be a reasonable assurance that the TMDL can be implemented. WLAs will be implemented through the NPDES permit process. According to the 40 CFR 122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs such as Section 319 of the CWA, commonly referred to as the Nonpoint Source Program. Additionally, Virginia's Unified Watershed Assessment, an element of the Clean Water Action Plan, could provide assistance in implementing this TMDL.

The TMDL in its current form is designed to meet the applicable water quality standards. However, due to the wildlife issue that was previously mentioned, the Commonwealth believes that it

may be appropriate to modify its current standards to address the problems associated with wildlife loadings. It is believed that because of the violation rate associated with the wildlife loadings and/or because of any modifications that may have been made, that Phase 1 of the implementation process will allow Holmans Creek to attain standards. The Commonwealth is investigating possibly changing the use of these waters, adding a minimum flow component, or having a natural condition amendment added to their standards.